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Abstract

Organic compounds released during the drying of wood chips emerge only after the bulk of the water is removed. The I nitial water loss appears to evaporatively cool the chip. The subsequent temperature rise then promotes the removal of the organics. Commercially dried flakes retain a substantial quantity of VOC material, indicating that only a fraction of the organics potentially available for removal is released during commercial drying.

The release of volatile organic compounds (VOCs) from wood drying operations is a contemporary environmental issue facing the forest products industry. Dryer temperatures and configurations vary with the product and the operation. For instance, a typical dryer for oriented strand board has inlet and outlet temperatures of approximately 1000°F and 250°F respectively, with the flakes being blown through the system with a residence time of about 10 minutes. The dryer atmosphere is complex, containing gaseous and aerosol organics, supersaturated water, and water droplets. Terpenes are the principal VOCs released, of which α-pinene is the major component (1,2). Despite their low vapor pressures, significant quantities of non-volatile compounds such as long chain fatty acids are also found in the stack (1), transported presumably through steam distillation. We have initiated a systematic

study of the mechanism of VOC release during wood drying. Our initial finding is that VOCs are principally released *only* after most of the water is removed, probably because water evaporatively cools the chip.

Wood flakes were obtained from the Georgia-Pacific oriented strand board facility at Dudley, NC. Measurements were made in a tube furnace which consisted of a 27" ceramic tube that passed horizontally through an electrically heated zone and extended on both sides of the zone. A dry air line was introduced into the cool pre-oven end of the tube along with a thermocouple whose probe tip was positioned in the heated part of the tube.

For the moisture loss experiments, the air stream was bubbled through a dry ice cooled methanol trap. Air flow was regulated at 1 L/min which allowed the tube volume to be swept once every minute. For VOC measurements the trap was removed, and the tube connected directly through heated lines to a JUM VE7 flame ionization analyzer (FIA) whose detector was set at 190°C. Air flow was regulated at 1.5 L/min which was the preset of the FIA sampling pump.

The amount of material (mainly water) lost from wood during drying is reported in Table 1. For the first three measurements, drying was continued for 30 minutes after which period the water ceased dripping into the condenser. Weight differences in the trap were obtained by weighing the entire trap. More wood was used in the remaining experiments and the heating pe-

riod was extended to one hour which was sufficient for full water removal. All samples were of green wood, i.e. before dryer. Control experiments with an empty boat showed a negligible weight loss. The average weight loss from the wood is 51% based on differences in wood weight, and 46% on the basis of the trap weight gain. The former is believed to be more reliable since some methanol could have been lost to the approximately 30L of air that bubbled through the trap. Since wood contains about 50% moisture, it is clear that the flakes are substantially dry in 30-60 minutes.

Typical FIA traces obtained during drying runs with green and dry wood are shown in Figure 1. The dry wood was obtained from the Dudley facility; i.e. it was dried in the field and not in the laboratory. The two traces reflect emissions from different charges of wood. The inherently high variability among wood samples precludes quantitative comparison of individual FIA traces; our focus here is on the location rather than on the intensity of the maxima. Note that emissions for green wood begin only after about 30 minutes, i.e. the organics emerge after the water is mostly gone. Since the vapor pressure of α-pinene is quite low at 5.91 torr at 30°C (3), the obvious explanation is that water cools the chip during its evaporation, and that the organics are released only after the subsequent temperature rise. Emissions for the dried chip begin almost immediately as shown in Figure 1, since the temperature of the flake rapidly reaches system temperature, thereby mobilizing the

organics. The lag between the release of water and VOCs offers real options for the reduction of VOCs during the drying process.

An ancillary qualitative observation confirmed in several replicate measurements is that dried and green flakes are associated with surprisingly similar quantities of volatile material, when both furnishes are normalized to a dry weight basis. This suggests that only a fraction of the VOCs potentially available for release is actually lost in the drying process, and that the total terpene content of wood is not a direct measure of the amount of VOC that is transferred to the air stream.

Acknowledgment

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Literature Cited

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Caption to Figure 1

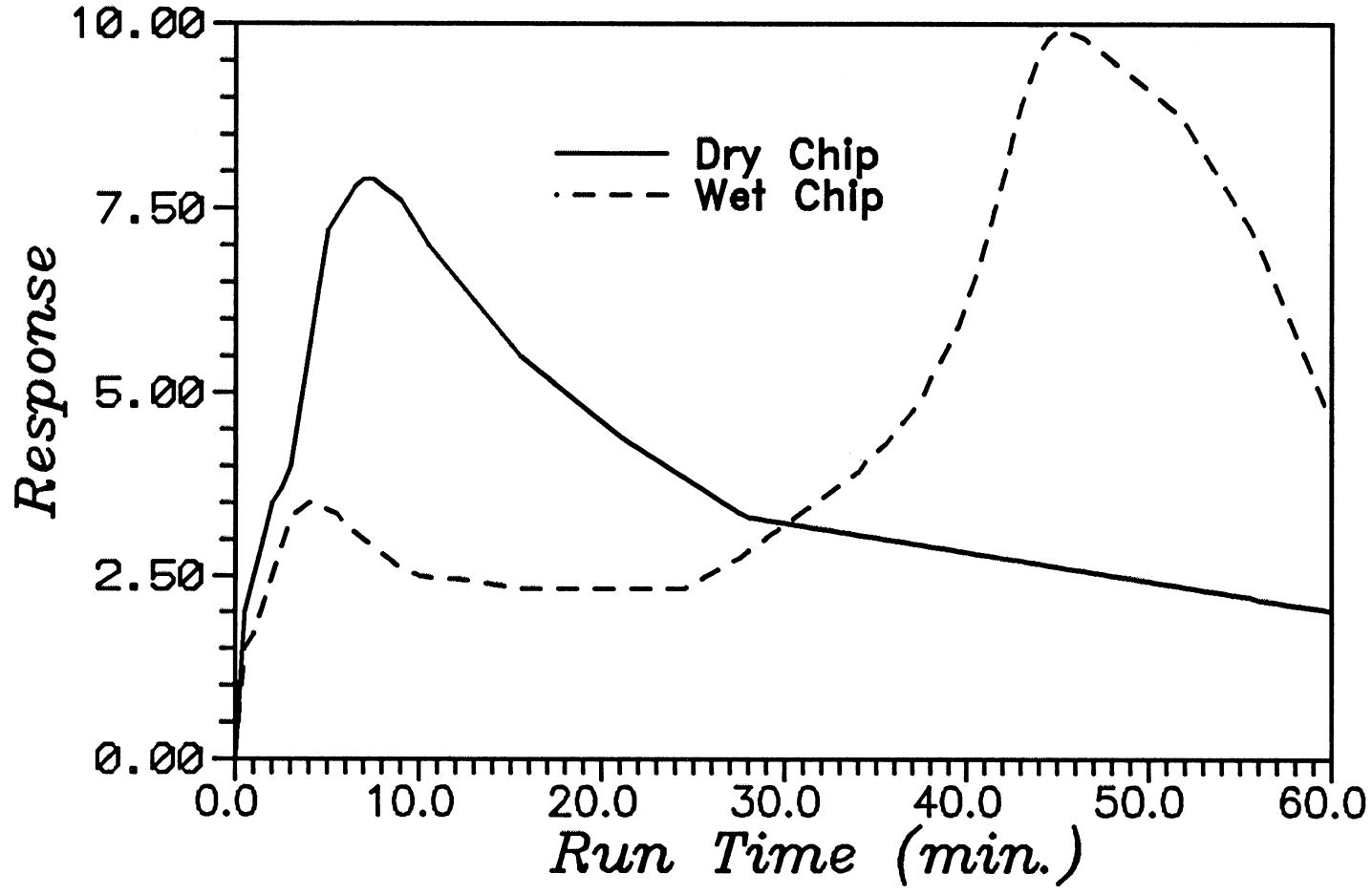
Flame ionization analyzer response during drying of green and dry wood chips.

TABLE 1 Weight loss in wood drying[1]

temp (C)	initial wt (g)	percent wt loss from wood	percent wt gain in trap
200	2.193	40	36
160	1.931	45	39
200	2.659	48	41
103	3.342	45	38
102	4.002	50	46
125	3.765	47	44
125	4.225	39	31
160	5.469	58	53
160	3.260	56	50
130	3.645	66	62
130	4.228	65	59
130	3.414	53	55
130	3.157	57	50

[1]Drying times for the first 3 entries was 30 minutes.

The others were dried for 1 hour.


10.00
7.50
5.00
2.50
0.00
Response
Dry Chip
Wet Chip
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Run Time (min.)